Introduction

The Committee for Analysis and Forecast Techniques Implementation (CAFTI), at its March 1 meeting, approved for implementation, the following changes to the Eta model:

1) an extension of the 00Z and 12Z runs of the Meso Eta out to 60 hours and the 06Z and 18Z runs out to 48 hours,
2) changes to the model output, featuring: more and higher resolution output via the AWIPS SBN, an alternate computation of the sea level pressure, and an improved computation of storm motion,
3) changes to the convective scheme,
4) a return to using the WSR-88D VAD winds with a new quality control code,
5) adding the computation of the precise location of each level of radiosonde data taking into account balloon drift.

These changes were implemented on March 29.

The following sections describe the changes, the reasons for the changes, and the impact of the changes on the operational use of the model output. A more comprehensive description of these changes, along with results from tests conducted prior to implementing these changes can be found in Technical Procedures Bulletin No. 465 available online at http://www.nws.noaa.gov/om/tpbpr.htm. Verification statistics from the test runs can be found at http://sgi62.wwb.noaa.gov:8080/ETA32PARA/.

Background

The changes to be summarized are for the operational 32km, 45-layer Eta model. This model has commonly been known as the "Early" Eta for the 00Z and 12Z runs and the Meso Eta for the off-time runs at 06Z and 18Z. NCEP now refers to all four runs as the Meso Eta and that nomenclature will be followed hereafter in this document.

The Meso Eta was officially implemented on the new NCEP IBM SP supercomputer in January 2000. The model is run 4 times per day at 00Z, 06Z, 12Z, and 18Z with identical resolution of 32km. Prior to March 29, output for the off-time 06Z and 18Z runs was only available out to 33 and 30 hours, respectively. Output for the on-time 00Z and 12Z runs was available out to 48 hours.

Extension of the Meso Eta Runs

The changes

With implementation of this change, processing of the off-time runs will be done out to 48 hours. Additionally, the on-time Meso Eta runs at 00Z and 12Z will be extended from 48 hours to 60 hours.

Reasons for the changes

The 00Z and 12Z runs will be extended to 60 hours in response to a numerous requests for extended "day 2" guidance.

Operational Impact

This is no direct operational impact. However, forecasters should be aware that tests indicate that Meso Eta tends to have lower RMS errors than the Aviation (AVN) run of the NCEP Global Spectral Model for the 60hr forecasts. The biggest differences between the models are seen in upper tropospheric heights, mid-tropospheric winds, and relative humidity. For additional details see TPB 465 available online at http://www.nws.noaa.gov/om/tpbpr.htm. Charts with quantitative verification statistics from parallel tests can be found at http://sgi62.wwb.noaa.gov:8080/ETA32PARA/.

Changes to Meso Eta Model Output

The changes

Changes to the Meso Eta model output are: 1) higher spatial and temporal resolution output, 2) an alternate computation of the sea level pressure, and 3) an improved computation of storm motion***.***

The output available from the Meso Eta model is unified so that the 40km grid #212 and 20km grid #215 output is available for all 4 forecast cycles and is available for the full length of each run at 3-hr timesteps.

Sea level pressure fields computed using the Shuell method are added to the model output files.

The model computation of storm motion is changed from a method based on climatology to one more physically-based.

Reasons for the changes

All 4 daily runs of the Meso Eta are now uniform in their resolution. Thus, it is desirable to unify the model output files. Previously the 00Z and 12Z Meso Eta runs were limited to the 80 km grid #211. These runs will now be available on the 40 km grid #212 and the 20 km grid #215.

The Shuell technique for computing sea level pressure has been requested by the field as an alternate option for viewing forecasts of sea level pressure. The Shuell method is designed to improve upon the simple standard reduction of pressure to sea level. Typically, the standard reduction makes use only of the lowest-layer temperature and a lapse rate of 6.5K per km. The Shuell method determines a ground temperature and places restrictions on the temperature increase used in the hydrostatic calculation of sea level pressure. For a detailed description of the method see Mesinger and Treadon (1995).

SPC has requested switching the storm motion computation to the Bunkers et al (1998) dynamic method to produce superior forecasts of helicity***.*** This replaces the Davies and Johns (1993) method for predicting the motion of supercell thunderstorms which was based on a climatology of central and eastern U.S. supercells. The dynamic method is a more physically-based computation and uses two components to predict storm motion: 1) the influence of the mean wind on initial cell motion and 2) the interactions of the updraft with the sheared environment.

Operational Impact

The 00Z and 12Z Meso Eta output will now include data on the high resolution grid #212 (40-km resolution) and grid #215 (20-km resolution). With this change, precipitation buckets for the higher resolution grids (#212 and #215) for the 00Z and 12Z runs will now be 3-hourly like those in the 06Z and 18Z runs. The low resolution grids (#211 and #104) will continue to contain the current 12-hour buckets to maintain connectivity to legacy systems and software.

All output files will now contain the sea level pressure computed with the Shuell reduction in addition to the value computed with the Eta Mesinger reduction. The primary differences between the two fields will be in high terrain areas

The Bunkers dynamic method to storm motion vectors tends to perform as well or better than the previous method in "classic" severe weather cases marked by upper right-quadrant hodographs. This method also tends to perform much better than the older method in cases marked by non-classic hodographs such as northwest-flow severe events.

Changes to the Convective Scheme

The changes

The Eta model uses the Betts-Miller-Janjic convective scheme. Changes have been made to the reference humidity profiles used by that scheme to reduce precipitation biases in the model.

Reasons for the changes

There are two well known regional precipitation biases in the Eta model. The model tends to produce too little precipitation over the higher terrain of the western United States and too much precipitation over the coastal regions of the Gulf and south Atlantic states. Both problems are related to the model's convective parameterization scheme.

The scheme formerly used different reference humidity profiles for model grid points over land versus those over water. The distinction between drier reference humidity profiles at land points and more moist profiles at water points is removed. The profiles have been unified to use the water profiles at all points. This eliminates a discontinuity in profiles at the coast that causes incorrect forecasts of heavy convective precipitation there. A complete discussion of the problems and corrections to the convective scheme is given in TPB 465.

Operational Impact

Verification of the new scheme shows a slight improvement to the threat scores with a decrease in bias when the entire model domain is considered. Inspection of individual regions, however, shows that the changes are having significant positive effects in the southeast U.S.

Return to Using the WSR-88D VAD Winds in Eta Analysis

The changes

A quality control program has been implemented to allow use of WSR-88D Vertical Azimuth Display (VAD) winds into the Eta assimilation system.

Reasons for the changes

The VAD winds represent a large data set that had to be turned off in January 1999 due to occasional bad data problems and contamination by migratory birds.

The processing of VAD winds into PREPBUFR format began at NCEP in July, 1995 and began to be assimilated by the operational RUC-2 system in June, 1997. The VAD winds were then assimilated operationally by the Eta's 3-dimension variational assimilation system in July, 1997 and by the Global SSI assimilation system in February, 1998. However, when the problems with the data became evident, all operational use of the VAD winds ended in January, 1999.

A quality control technique was developed that specifically identifies errors with different characteristics. The quality control program includes a check for migratory birds in the processing of VAD winds. This permits the inclusion of this data set into the assimilation.

Operational Impact

The initial Meso Eta fields should be more representative of actual conditions.

Calculation of Radiosonde and PIBAL Balloon Drift

The changes

The drift of radiosondes and PIBAL balloons is now accounted for in the processing of that data. Updated latitude, longitude, and time are computed for each reported level of data.

Reasons for the changes

It is desirable to compute the drift of the radiosonde balloon and produce a unique latitude/longitude location for each level of the ascent. Prior techniques inaccurately treated the data as a vertical ascent directly above the radiosonde release location. The new balloon drift calculations involve estimating an updated latitude, longitude and observation time on each reported level as the radiosonde or PIBAL balloon ascends through the atmosphere.

Operational Impact

The initial Meso Eta fields should be more representative of actual conditions.

References

Mesinger, F. and R. E. Treadon, 1995: "Horizontal" reduction of pressure to sea level: comparison against the NMC's Shuell Method. *Mon. Wea. Rev.,* **123**, 59-68.

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